

59<sup>th</sup> Medical Wing, 59<sup>th</sup> Dental Squadron, Endodontics Flight:

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### List of Articles

*Click on the article you wish to view*

- Cyclic fatigue testing of nickel-titanium endodontic instruments.
- Inflammatory response to calcium hydroxide based root canals sealers.
- Analysis of the forces developed during obturation: warm vertical compaction.
- Thermal effects and antibacterial properties of energy levels required to sterilize stained root canals with an Nd:YAG laser.
- 3D reconstruction of two C-shaped mandibular molars.
- The investigation of biocompatibility and apical microleakage of tricalcium phosphate based root canal sealers.
- Identification and antibiotic sensitivity of bacteria isolated from periapical lesions.
- Defense responses of dentin/pulp complex to experimentally induced caries in rat molars: an immunohistochemical study on kinetics of pulpal Ia antigen-expressing cells and macrophages.
- Titanium-inlay - A new root-end filling material.
- A comparison of clinical root canal therapy performed by third-year dental students using Canal Master instruments to that performed using K-files.
- Some unusual clinical cases on root anatomy of permanent maxillary molars.

**Pruett JP, Clement DJ, Carnes DL. Cyclic fatigue testing of nickel-titanium endodontic instruments. J Endodon 1997;23:77-85.**

**PURPOSE:** The first was to introduce a new method of determining canal curvature. The second examined the effect of cyclic fatigue in Lightspeed instruments.

**M&M:** 18 groups of instruments, size 30 and 40 Lightspeed, were tested in a Dynamometer at angles of curvature of 30, 45 and 60°. Radii of curvature was either 2 or 5 mm, representing abrupt or sweeping curves respectively. Preformed stainless steel tubes at these angles were fabricated. The instruments were inserted, at speeds of 750, 1300, or 2000 rpm, and cycled till they failed. Data collection was by computer, and the cycles to failure was analyzed with respect to each of the factors: rpms, instrument size, angle of curvature and radius of curvature.

**RESULTS:** The 2 points of curvature are noted on the canal, and a radius of curvature that intersects both of these is determined with a circle gauge. Tangential lines drawn perpendicular to these radii intersect, and the angle of curvature is measured from there. No difference in operating rpm within the 2 groups of instrument sizes was noted. As instrument shaft diameter increased, the cycles to failure decreased. As the radius of curvature decreased, the cycles to failure decreased. Instruments in the 45 and 60° groups had lower cycles to failure than the 30° groups. Instrument separation was always within 5 min, and at the midpoint of the curve. SEM analysis showed fractures located at the point of maximum curvature in instruments cycled to ~ 80% to failure. These fractures were not visible when the instrument was not flexed, or to the naked eye when flexed. Fracture was via crack propagation until ultimately a ductile fracture occurred in the center of the file.

**C&C:** The new method of describing canal curvature is clinically applicable. We all knew that a sharp curve was worse than a broad sweeping one. The fact also that these instruments gave no visible sign of fracture or deformation is worrisome. It becomes inevitable that some of these instruments will separate in the canals, regardless of our replacement scheme. I agree that ANSI 28 needs revision or additions to cover the engine-driven Ni-Ti instruments.

**February 1997**

**Robin E. Hinrichs**

**Silva LAB, Leonardo MR, Faccioli LH, Figueiredo F. Inflammatory response to calcium hydroxide based root canals sealers. J Endodon 1997 23:86-90.**

**PURPOSE:** To evaluate the inflammatory response induced by Sealapex, CRCS, Sealer 26, and Apexit when injected into the subcutaneous tissue and peritoneal cavity of mice.

**M&M:** Eighty mice were divided into 4 groups, each injected with a subcutaneous suspension consisting of one of four ground set root canal sealers: group 1 - Sealapex; group 2 - CRCS; group 3 - Sealer 26; and group 4 - Apexit. Five animals were selected at random and sacrificed at 2, 4, 8, and 16 days. The injected site was then histologically evaluated. One hundred mice had the same procedure completed, but the suspension was injected intraperitoneally. A control group was injected with PBS alone. Five animals from each group were sacrificed 6 and 24 hours, and 5 and 15 days after injection. Slide smears were prepared from a peritoneal wash, and differential counts of mononuclear cells were performed.

**RESULTS:** *Subcutaneous tissue:* Cell kinetics were classified as initial, intermediate and late phases. During the initial phase, large amounts of PMN's were observed in response to all sealers, being more intense to CRCS and Apexit. In some cases, Sealer 26 and Sealapex caused localized tissue necrosis. CRCS and Apexit induced necrosis scattered among inflammatory cells. In the intermediate phase, there was a sharp reduction in the number of PMN's. A progressive increase in mononuclear cells occurred, varying according to the sealer tested. The late phase was characterized by few neutrophils and an intense granulomatous reaction with a predominance of epithelia cells and multinucleate giant cells (except in response to Apexit). Necrosis was noted in response to Sealer 26, CRCS, and Apexit. *Cell migration in the peritoneal cavity:* All four root canal sealers induced a significant increase in neutrophil numbers at 6 hours. Apexit induced the largest number, followed by Sealer 26. Sealapex and CRCS induced the smallest number of neutrophils. Twenty-four hours after injection, Sealapex, CRCS and Apexit induced similar neutrophilia, which was lower than that induced by Sealer 26. At five days, there was a marked decrease in neutrophil number, and by 15 days, the neutrophil numbers returned to control levels in all groups. There was no significant difference in mononuclear cell numbers detected among the sealers at any of the times tested. A significant difference in mononuclear cell number was observed only at 6 and 24 hours when comparing the four sealers to the control.

**C&C:** The highest cell differentiation was observed in response to Sealapex, which was attributed to the low solubility of the material and its high  $\text{Ca}^{2+}$  concentration. This is in contrast to CRCS, which does not readily release  $\text{Ca}^{2+}$ .

**February 1997**

**Orest M. Harkacz, Sr.**

**Blum JY, Parahy E, Micallef JP. Analysis of the forces developed during obturation: warm vertical compaction. J Endodon 1997;23:91-5.**

**PURPOSE:** To determine and display the vertical and lateral forces developed during an obturation using the warm vertical compaction technique.

**M&M:** 2 transducers were attached to a device containing decoronated roots that had been prepared apically to size 45. 5 endodontists and 5 dental students participated. 4 instruments, set at the orifice, halfway, and 7 and 9 mm short of root length, were used. Each operator performed 5 sessions of 4 compactions, with the computer readout of forces reviewed after each session.

**RESULTS:** During the 1st three sessions, the students exerted lower forces than the endodontists. During the final 2 sessions, there was no difference. The students used more compactions in the 1st 3 sessions, and had greater lateral forces in all the sessions. The endodontists averaged  $2.5 \pm 0.4$  kg per compaction vertically, and  $0.85 \pm 0.2$  kg in lateral forces. Endodontist always performed the final long compaction, but were unable to exert a constant force. 2 failures in obturation were discussed, and were attributed to a lack of sufficient vertical forces at the beginning of obturation.

**C&C:** As the authors mention, warm vertical compaction produces more vertical and lateral forces than lateral condensation. The authors were careful to assure that the pluggers did not contact the walls by presetting stops on them, but the students probably still had difficulty maintaining a vertical orientation.

**February 1997**

**Robin E. Hinrichs**

**Ramsköld LO, Fong CD, Strömberg T. Thermal effects and antibacterial properties of energy levels required to sterilize stained root canals with an Nd:YAG laser. J Endodon 1997;23:96-100.**

**PURPOSE:** To evaluate the use of a Nd:YAG laser for endodontic purposes with emphasis on 1) the thermal effects of intracanal lasing on the periradicular tissue, and 2) the antibacterial effects on dark-stained bacteria to establish a clinically safe level of energy introduced into the root canal.

**M&M:** A Nd:YAG Laser-35 was utilized at 3W (50 Hz and 60 mJ). The total energy delivered per 15-s period was 45 J. For the in vitro experiments, thermocouples were attached to the root surfaces of extracted single-rooted teeth. The canals were prepared to an ISO size #50. The fiber of a Nd:YAG laser was inserted and activated into the dry root canals. Temperature changes were recorded first during continuous lasing for 30 s and subsequently for a combination of 15 s lasing followed by a 15-s recovery interval, repeated several times. To test the antibacterial properties of laser irradiation, pure cultures of *Enterococcus faecalis* and *Streptococcus mitis* were inoculated into root canals. Twenty teeth were divided into two groups of ten teeth each. Eight teeth per group were subjected to lasing, and two were used as controls. Group 1 was lased for two 15-s periods with a 15-s recovery interval between lasings. Group 2 was lased for four 15-s intervals, with a similar recovery interval after each. Control teeth were not lased.

**RESULTS:** In the temperature study, a test with 30 s lasing with no recovery interval resulted in a temperature rise from 33.5 °C to 43.2°C. Seven subsequent lasing intervals were performed with 15-s of lasing followed by 15-s of recovery. The first lasing interval began at 34.1°C and caused a temperature increase of 6.0° to 40.1°C. During the recovery interval the temperature dropped 3.9° to 36.2°C. The following six lasing and recovery intervals yielded temperature peaks of 41.5 to 42.6°C and lows of 36.7 to 37.1°C. The results of the antibacterial tests showed that in Group 1, there was bacterial growth in samples from 6 of 8 teeth. In Group 2, there was bacterial growth in 1 of the 8 samples. All controls showed growth.

**C&C:** This study indicates that for the parameters under which this experiment was carried out, multiple lasings would be required to attempt to sterilize the root canal. Different results may be obtained between lasing in a wet canal vs. lasing in a dry canal. Also, the efficiency of a laser depends upon its absorption into a particular material. Therefore, different effects may also be obtained with darker vs. lighter colored dentin.

**February 1997**

**Orest M. Harkacz, Sr.**

***Lyroudia K, Samakovitis G, Pital I, Lambrianidis T, Molyvdas I, Mikrogeorgis. 3D reconstruction of two C-shaped mandibular molars. J Endodon 1997;23:101-4.***

**PURPOSE:** To make a computerized 3D reconstruction of C-shaped canal morphology in 2 mandibular molars.

**M&M:** 2 extracted man molars with c-shaped canals were embedded, sectioned in 1mm increments, and the photographic images of these sections scanned into a computer. A visual image was created of the exterior, inner surface of the pulp, and root canals.

**RESULTS:** It worked. The black and white photos are pretty clear. Each tooth is different with respect to the number of canals involved in the C, and the number of foramen.

**C&C:** Color photos are probably even better. This would make a good teaching tool, especially if models of these teeth were fabricated with an incredibly expensive machine.

**February 1997**

**Robin E. Hinrichs**

**Bilginer S, Esener IT, Söylemezoglu F, Tiftik AM. The investigation of biocompatibility and apical microleakage of tricalcium phosphate based root canal sealers. J Endodon 1997;23:105-9.**

**PURPOSE:** To determine the biocompatibility and apical sealing ability of  $\alpha$ -tricalcium phosphate based Sankin Apatite (SA) Type I, Type II, and Type III root canal sealers.

**M&M:** *Biocompatibility study* - 140 sterile teflon tubes, 10 mm long and 1.3 mm in internal diameter, were filled flush with freshly mixed SA Type I, Type II, and Type III, or Grossman's Cement (GC) and implanted into the subcutaneous connective tissue of 31 mice. Twelve empty tubes were implanted in 3 mice as controls. At the end of the experimental period (24 h, 7, and 30 days), the animals were sacrificed and the implants along with surrounding tissue were prepared for histologic evaluation. *Apical leakage study* - 54 single straight canaled human teeth were prepared to a minimum size #45 with step-back flaring. Five teeth were obturated with lateral condensation using gutta-percha and no sealer (positive control). Five unfilled teeth were completely coated with sticky wax (negative control). The remaining teeth were obturated using lateral condensation of gutta-percha and SA Type I, Type II, Type III, or GC sealer. The cervical portion of the roots were covered with sticky wax, and the teeth were allowed to set for 48 h, after which they were immersed in 2% methylene blue dye for 48 h. The apical root end of each tooth was then cut off until the tip of the gutta-percha was visible (to eliminate dye in the delta area of the apex). Leakage was quantitatively measured by dissolving the roots in nitric acid and analyzing the resulting solution with a spectrophotometer to determine the concentration of methylene blue dye in the solution.

**RESULTS:** *Biocompatibility* - At the end of 24-h, SA Type II, Type III, and the control had a mild acute inflammatory reaction. A mild/moderate inflammatory response was observed in SA Type I, and a moderate acute inflammatory reaction was found in GC. After 7 days, a mild/moderate inflammatory response with intensive PMN's and many lymphocytes, macrophages and plasma cells was observed with SA Type II and III specimens. A moderate inflammatory response was observed with Type I and control specimens, with half the Type I specimens exhibiting necrosis. GC specimens yielded a moderate/severe inflammatory response. All specimens at day 7 had a fibrous capsule around them. After 30 days, all reactions were of a chronic nature. SA Type I, II, and III specimens had a mild/moderate inflammatory response, GC specimens yielded a moderate inflammatory response, and controls yielded a mild inflammatory response. Type I had a less mature fibrous capsule compared to the remaining specimens. *Apical leakage* - No significant difference in spectrophotometrically measured leakage was noted among the teeth obturated with the test materials.

**C&C:** According to the authors, SA Type II and III contain iodoform, and were found more biocompatible than Type I and GC. In general, all the sealers had minimal dye leakage under the design of this experiment. The article evaluated the 3 different types of Sankin Apatite sealers, which differed in chemical composition, but no information was given as to what purpose or situation each type of formulation was designed for. According to the authors, the severity of the reaction among the tested materials decreased with time.

**February 1997**

**Orest M. Harkacz, Sr.**

**Vigil GV, Wayman BE, Dazey SE, Fowler CB, Bradley DV. Identification and antibiotic sensitivity of bacteria isolated from periapical lesions. J Endodon 1997;23:110-4.**

**PURPOSE:** To further characterize the type and antibiotic sensitivity of bacteria isolated from periapical lesions refractory to nonsurgical endodontic therapy.

**M&M:** 30 periradicular lesions were collected during surgery after conventional endodontics had failed to resolve the conditions. The tissue was washed 3 times and divided in half. Half was sent for microscopic analysis, and half was placed in Reduced Transport Fluid and submitted for culture. Bacteria that were cultured were identified, and sensitivity and specificity was determined.

**RESULTS:** 2 specimens were discarded because of breaks in protocol. 21% of the specimens (6) showed no growth. 2 of these 6 had been on antibiotics for 1 wk prior to surgery. The most common isolates were *Propionibacterium acnes*, *Staphylococcus epidermidis*, and *Streptococcus intermedius*. 10 of the 15 lesions with no visible oral communication yielded mixed cultures, averaging 2.3 isolates each. 12 of the 13 with possible communication yielded positive culture growth. 9 were polymicrobial, averaging 2.5 per case. The most common isolates were *Wolinella recta*, *Fusobacterium*, and *Clostridium* species. In nearly all cases of growth there was a mix of obligate and facultative MO's, and the other half had obligate or facultative specimens. 93% were granulomas, 7% were cysts. Foreign matter was seen in 25%. Antibiotic resistance was common, although not considered significant.

**C&C:** A good study, but the numbers are low. More specimens might have increased the number of *Bacteriodes*, as the authors suggest.

**February 1997**

**Robin E. Hinrichs**



**Kamal AMM, Okiji T, Kawashima N, Suda H. Defense responses of dentin/pulp complex to experimentally induced caries in rat molars: an immunohistochemical study on kinetics of pulpal Ia antigen-expressing cells and macrophages. J Endodon 1997;23:115-20.**

**PURPOSE:** To examine the distributional and numerical changes of Ia antigen-expressing cells following varying periods of caries induction.

**M&M:** *Streptococcus mutans* was utilized to induce caries in pathogen-free rats. Control animals were not inoculated. Periods of caries induction were set at 8, 12, and 16 wks. At the given periods, the animals were sacrificed and prepared for histologic sections using HE and immunoperoxidase staining. Mouse antirat monoclonal antibodies ED1 (anti macrophages and dendritic cells), ED2 (anti tissue macrophages), and OX6 (anti Ia antigen) were used as the primary antibodies in the immunoperoxidase staining.

**RESULTS:** Dentinal caries of various depths, both proximal and occlusal, developed in almost all molar teeth. No detectable caries were observed in the controls. Caries depth increased with the period of caries induction. Teeth with deep caries usually displayed a more extensive inflammatory cell infiltration compared with those with the superficial caries. In the control teeth from every period, ED1+ and ED2+ cells displayed a relatively random distribution throughout the entire pulp, while OX6+ cells usually concentrated in and around the odontoblastic layer of the coronal pulp. In the carious teeth, cells positive to each antibody tended to increase their density in the coronal pulp. Quantitative assessment of the positively stained cells in the coronal pulp at each interval revealed that ED1+ , ED2+, and OX6+ cells in the experimental group significantly increased compared to the corresponding controls. OX6+ cells showed a prominent increase at 8 weeks. At 16 weeks, ED2+ cells were the most prominent.

**C&C:** The kinetics of the above experiment reveals that the initial pulpal response was characterized by a localized accumulation of Ia antigen-expressing cells beneath the dentinal tubules communicating with the superficial caries. This was followed by a caries-depth related increase of Ia antigen-expressing cells and macrophages in the coronal pulp (this was most apparent when the caries had progressed into the reparative dentin). According to the authors, this suggests that the response of Ia antigen-expressing cells to carious irritants triggers the defense reactions of the pulp. They speculated that the intensity of the defense reactions may be correlated with the permeability of the carious dentin. The data also indicate that the depth of the caries is more critical than the period of caries induction in eliciting the inflammatory reaction of the pulp.

**February 1997**

**Orest M. Harkacz, Sr.**

**Sumi Y, Hattori H, Hayashi K, Ueda M. Titanium-inlay - A new root-end filling material. J Endodon 1997;23:121-3.**

**PURPOSE:** To present a "new" material and technique for root-end fillings.

**SUMMARY:** Titanium inlays were prefabricated in 3 sizes, corresponding to the ultrasonic tip sizes. After preparation of the root end, the appropriate inlay is cemented with SuperEBA cement. This decreases the amount of Super EBA exposed to the periradicular tissues, decreasing its cytotoxic effects. 108 teeth in 48 patients were presented, w/ follow-up for up to on year, but most were only 6 mo. No problems were noted in any.

**C&C:** Besides the obviously short follow-up period, why do this at all? Another element is added to the procedure, complicating it. The biggest concern I have is the treatment of fins and isthmi. In the root-end preparation shown, the isthmus was not prepared. My concern is that the preparation for the inlay will override the removal of all possible sources of leakage. Maybe a titanium cement could be developed.

**February 1997**

**Robin E. Hinrichs**

**Alexander JB, Carnes DL, Gilles JA. A comparison of clinical root canal therapy performed by third-year dental students using Canal Master instruments to that performed using K-files. J Endodon 1997;23:124-8.**

**PURPOSE:** To radiographically compare clinical root canal therapy performed on the mesial roots of mandibular molars by third-year dental students during an academic year when all instrumentation was performed with K-files to that performed the subsequent year by third-year students using the Canal Master (CM) system. This was done to determine if improvement previously seen in a nonclinical comparison would be demonstrated in clinical cases.

**M&M:** Sixty-nine K-file and 52 CM cases of lower molar root canal therapy performed by third-year dental students were evaluated. Obturation in all cases was accomplished using laterally condensed gutta-percha. Periapical radiographs (preoperative, length determination, condensation, and postoperative views) were evaluated by a panel of 5 endodontists under 10x magnification who rated the quality of the root canal therapy by maintenance of length during instrumentation, maintenance of original canal shape, instrumentation to adequate size, and quality of fill to working length without voids.

**RESULTS:** *Length maintenance* - Maintenance of length during instrumentation with CM instruments was rated significantly better than with K-files by 2 evaluators. No significant differences between the two techniques were noted by the remaining evaluators. *Original shape of canal maintained* - Four evaluators rated the CM significantly better compared to the K-file in maintaining canal shape. The remaining evaluator rated the CM better, though statistical significance was not achieved. *Canal instrumented to adequate size* - Three evaluators rated the CM significantly better than K-files. *Fill to working length without voids* - Three evaluators indicated significant improvement in fill quality of CM cases compared to K-file cases. No significant difference was indicated for the ratings of the other two evaluators. *Final score* - The median score for the CM cases was significantly higher than the median score for the K-file cases.

**C&C:** No evaluator rated any category significantly better with the use of K-files. Variables to consider: no standardized method of film placement (angulations could vary from film to film), how did the evaluators determine that enlargement was sufficient to clean the canal of pulpal tissue from radiographs, the instrumentation techniques were not comparable (they compared a filing vs. a rotational technique). As an aside, the incidence of instrument separation was greater with the CM than K-files, most likely due to the instrumentation techniques involved.

**February 1997**

**Orest M. Harkacz, Sr.**

***Malagnino, V, Gallottini L, Passariello P. Some unusual clinical cases on root anatomy of permanent maxillary molars. J Endodon 1997;23:127-8.***

**PURPOSE:** To present 3 cases of unusual anatomy in maxillary molars.

**SUMMARY:** 3 max molars, two seconds and one first were presented. The MB and DB canals merged to one and exited with a common foramen. The authors called the resultant fill an inverted Y effect. Working length radiographs should alert the practitioner, who can then take appropriate measures during preparation and obturation.

**February 1997**

**Robin E. Hinrichs**